

University of Dundee

Assessment of the mechanism of fracture propagation of soft rock coastal cliffs by using non-local constitutive models

Lollino, Piernicola; Fazio, Nunzio Luciano; Perrotti, Michele; Genco, Alessio; Elia, Gaetano; Ciantia, Matteo Oryem

Published in:
EGU General Assembly 2020

DOI:
[10.5194/egusphere-egu2020-19783](https://doi.org/10.5194/egusphere-egu2020-19783)

Publication date:
2020

Licence:
CC BY

Document Version
Publisher's PDF, also known as Version of record

[Link to publication in Discovery Research Portal](#)

Citation for published version (APA):

Lollino, P., Fazio, N. L., Perrotti, M., Genco, A., Elia, G., & Ciantia, M. O. (2020). Assessment of the mechanism of fracture propagation of soft rock coastal cliffs by using non-local constitutive models. In *EGU General Assembly 2020* [EGU2020-19783] European Geosciences Union. <https://doi.org/10.5194/egusphere-egu2020-19783>

General rights

Copyright and moral rights for the publications made accessible in Discovery Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from Discovery Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain.
- You may freely distribute the URL identifying the publication in the public portal.

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

EGU2020-19783

<https://doi.org/10.5194/egusphere-egu2020-19783>

EGU General Assembly 2020

© Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.



Assessment of the mechanism of fracture propagation of soft rock coastal cliffs by using non-local constitutive models

Piernicola Lollino¹, Nunzio Luciano Fazio¹, Michele Perrotti¹, Alessio Genco², Gaetano Elia², and Matteo Oryem Ciantia³

¹CNR - IRPI, Bari, Italy (p.lollino@ba.irpi.cnr.it)

²DICATECh, Technical University of Bari, Italy

³School of Science and Engineering, University of Dundee, UK

The assessment of susceptibility to failure of soft rock coastal cliffs, along with the associated failure mechanism, is not a simple task. Equilibrium conditions depend on the combination of several factors such as structural setting, rock mechanical strength, weathering processes, the hydro-mechanical action of sea waves, the variation of the rock cliff geometry, to mention some of the most important ones. From a geomechanical perspective, the brittle - strain softening behaviour of the rocks plays a key role in the onset and propagation of failure (Ciantia & Castellanza 2015). In particular, the rapid strength reduction occurring after peak under mechanical loading leading to localised deformations within shear fractures is detrimental for rock cliffs. Taking rock brittleness into account in numerical simulations under the framework of continuum mechanics is not straightforward, due to the problems related to a strong dependence of the numerical results from the adopted mesh when strain-softening laws are implemented (Vermeer and Brinkgreve 1994). Nowadays, several regularization techniques are available to control the size of the localised region and prevent the mesh dependence. Within regularization techniques, the nonlocal integral type solution has the advantage of not changing the field equations which facilitates numerical implementation. In this approach, the chosen nonlocal variables are valuated from spatial averages of the field variables in a neighbourhood, and the constitutive model is updated by replacing a local variable with its nonlocal counterpart. Consequently, the constitutive response of a Gauss point is influenced by all the integration points within a neighbourhood, with the size determined through a characteristic length (Bažant and Jirásek 2002). This contribution addresses the problem of the stability of an ideal 2-D plane strain coastal cliff, 20-m high, by means of the use of a non-local constitutive model implemented in a commercial finite element code (Mánica et al. 2018). The numerical results show insights into the evolution of the strain field and the process of slip surface/fracture propagation in the rock cliff as well as highlight the importance of regularising the finite element solution in the presence of brittle materials.